Atmel AVR1924: XMEGA-A1 Xplained Hardware User's Guide

Features

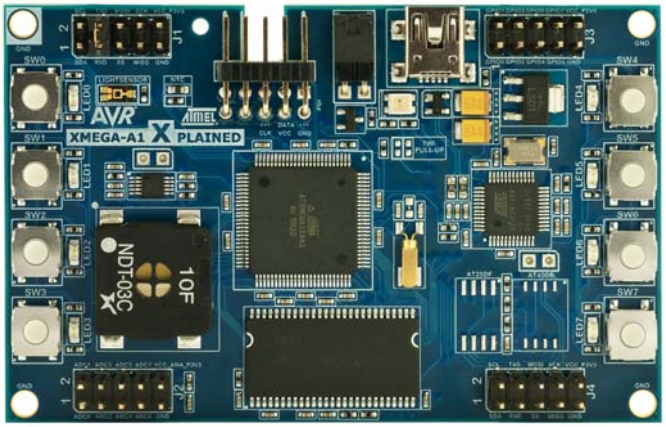
- Atmel® ATxmega128A1 microcontroller
- External memory
  - 8MB SDRAM
- Atmel AT32UC3B1256
  - Communication gateway
  - Programmer for Atmel AVR® XMEGA®
- Analog input (to ADC)
  - Temperature sensor
  - Light sensor
- Analog output (from DAC)
  - Mono speaker via audio amplifier
- Digital I/O
  - UART communication through USB gateway
  - Eight mechanical button switches
  - Eight LEDs
  - Eight spare analog pins
  - 24 spare digital pins

1 Introduction

The Atmel XMEGA-A1 Xplained evaluation kit is a hardware platform to evaluate the Atmel ATxmega128A1 microcontroller.

The kit offers a larger range of features that enables the Atmel AVR XMEGA user to get started using XMEGA peripherals right away and understand how to integrate the XMEGA device in their own design.

Figure 1-1. XMEGA-A1 Xplained evaluation kit.



8-bit Atmel Microcontrollers

Application Note

Preliminary

Rev. 8370C-AVR-12/11

2 Related items

Atmel FLIP (Flexible In-system Programmer)
http://www.atmel.com/dyn/products/tools_card.asp?tool_id=3886

Atmel AVR Studio® 4 (free Atmel IDE)
http://www.atmel.com/dyn/products/tools_card.asp?tool_id=2725

Atmel AVR JTAGICE mkII (on-chip programming and debugging tool)
http://www.atmel.com/dyn/products/tools_card.asp?tool_id=3353

Atmel AVR ONE! (on-chip programming and debugging tool)
http://www.atmel.com/dyn/products/tools_card.asp?tool_id=4279

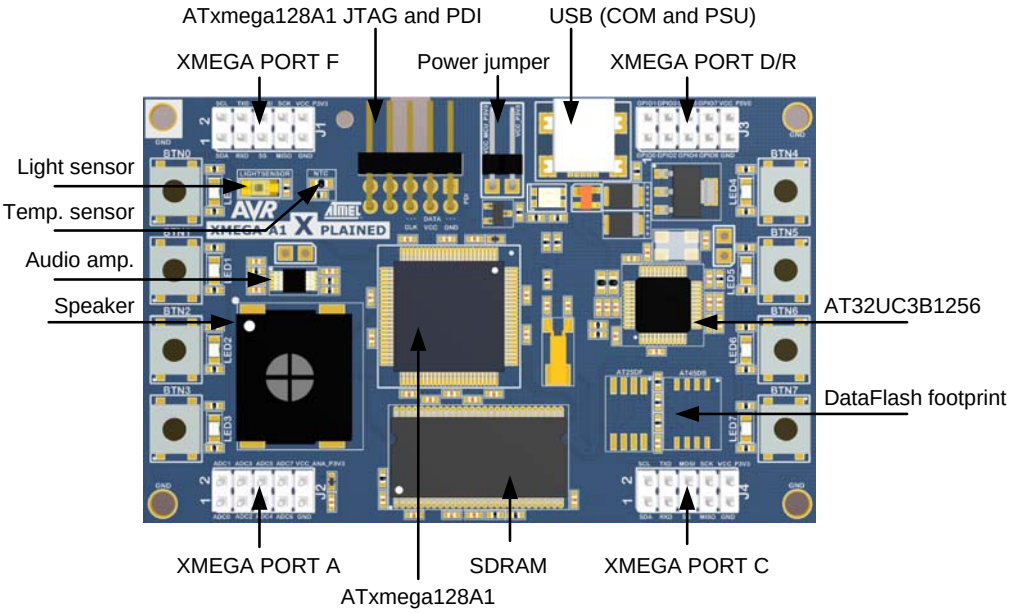
3 General information

This document targets the Atmel XMEGA-A1 Xplained evaluation kit, revision 9. The schematic, layout, and bill of materials can be found online in the zip files associated with this application note at:

http://www.atmel.com/products/AVR/xplain.asp?family_id=607&source=redirect.

The XMEGA-A1 Xplained kit is intended to demonstrate the Atmel ATxmega128A1 microcontroller, and the hardware that relates to the Atmel AT32UC3B1256 is, therefore, not covered in this document.

Figure 3-1. Overview of the XMEGA-A1 Xplained kit.



3.1 Preprogrammed firmware

The Atmel ATxmega128A1 and AT32UC3B1256 that come with the Atmel XMEGA-A1 Xplained kit are both preprogrammed.

The preprogrammed firmware in the XMEGA plays different sounds when the mechanical button switches are pushed.

The preprogrammed Atmel AT32UC3B1256 firmware offers features such as a boot loader for self-programming and a UART-to-USB gateway.

3.2 Power supply

The kit is powered via the USB connector, which leaves two options to power it: Connect the kit either to a PC through a USB cable, or to a 5V USB power supply (AC/DC adapter).

3.3 Measuring the XMEGA power consumption

As part of an evaluation of the Atmel ATxmega128A1, it can be of interest to measure its power consumption. The power jumper (J300) is connected between the 3.3V regulated voltage from the regulator and the ATxmega128A1 supply. By replacing the jumper with an ammeter, it is possible to measure the current consumption of the ATxmega128A1. No other components are connected to the same supply as the ATxmega128A1, and other components, therefore, do not affect the measurement of the ATxmega128A1 current consumption (except the DC leakage in the decoupling capacitors).

3.4 Programming the XMEGA through the UART-to-USB gateway

The ATxmega128A1 has a pre-programmed UART boot loader. How to program the device through the UART-to-USB gateway is described in the Atmel application note "AVR1927: XMEGA-A1 Xplained Getting started guide".

3.5 Communication through the UART-to-USB gateway

The XMEGA UARTC0 is connected to a UART on the AT32UC3B1256. The AT32UC3B1256 UART is communicating at 115200 baud, using one start bit, eight data bits, one stop bit, and no parity.

When the AT32UC3B1256 device is enumerated (connected to a PC), the data transmitted from the XMEGA is passed on to a (virtual) COM port. This means that it is possible to use a terminal program to receive the transmitted data on a PC. Similarly, data transmitted from the PC COM port is passed on to the XMEGA UART through the gateway.

NOTE

The AT32UC3B1256 is also connected to the shared SPI and TWI lines, and so it is also possible to add TWI and SPI gateway functionality for these serial interfaces, if desired. This gateway functionality is not available in the default firmware for the AT32UC3B1256. Please refer to the schematics for more information about these connections.

4 Connectors

The Atmel XMEGA-A1 Xplained kit has five 10-pin, 100mil headers. One header is used for programming the Atmel ATxmega128A1, and the others are used to access spare analog and digital pins on the XMEGA (expansion headers).

4.1 Programming headers

The XMEGA can be programmed and debugged by connecting an external programming/debugging tool to the JTAG and PDI header (J201). The header has a standard JTAG programmer pin-out (refer to online help in the Atmel AVR Studio), and tools like the JTAGICE mkII or AVR ONE! can thus be connected directly to the header. If it is desired to use PDI programming/debugging, an adapter must be used.

Due to physical differences of the JTAGICE mkII and AVR ONE! probes, the PCB has an opening below the JTAG and PDI header. This is to make room for the orientation tap on the JTAGICE mkII probe.

Because JTAG TDO and PDI DATA are connected on the PCB for this kit, JTAG must be disabled on the device in order to use PDI. The reason for this is that when JTAG is enabled it will enable a pull-up internally on TDO which interferes with the PDI initialization sequence.

The connection of JTAG_TDO with PDI_DATA is also an issue when the application on the device uses the JTAG_TDO pin e.g. by driving this pin actively or by using a pull-up. This will interfere with ongoing PDI communication. Additionally, when JTAG is disabled and the application is driving the JTAG_TDO pin it might even be not possible to establish a PDI connection. A workaround for this is to add a ~1k resistor from PDI_CLK/RESET to GND. This will keep the device in reset while PDI is enabled. When a PDI connection is established the flash can be erased or JTAG can be enabled in order to "unlock" the kit.

Table 4-1. XMEGA programming and debugging interface – JTAG and PDI.

J201 pin	JTAG [1]	PDI [2]
1	TCK	-
2	GND	GND [3]
3	TDO	DATA
4	VCC	VCC [3]
5	TMS	-
6	nSRST	CLK
7	-	-
8	-	-
9	TDI	-
10	GND	GND [3]

Notes:
1. Standard pin-out for JTAGICE mkII and other Atmel programming tools.
2. Requires adapter to connect a JTAGICE mkII (refer to AVR Studio help).
3. It is only required to connect on VCC/GND pin.

The Atmel AT32UC3B1256 can be programmed through its boot loader. The boot loader is evoked by shorting the J600 jumper before applying power to the board. The

programming is performed through the FLIP plug-in in AVR Studio (which can also be started as a standalone application).

FLIP (Flexible In-system Programmer) is free Atmel proprietary software that runs on Windows® 9x/Me/NT/2000/XP and Linux® x86. FLIP supports in-system programming of flash devices through RS232, USB, or CAN.

Alternatively, the AT32UC3B1256 can be programmed by connecting a programming tool, such as JTAGICE mkII, to test points TP600-607.

NOTE

It is not recommended to program the AT32UC3B1256 using a programming tool, as this will erase the boot loader.

4.2 I/O expansion headers

The XMEGA analog PORTA is available on the J2 header. This allows the user to connect external signals to the analog-to-digital converter (ADC), digital-to-analog converter (DAC), and analog comparators on PORTA.

The XMEGA digital PORTF and PORTC are available on the J1 and J4 headers, respectively. These ports feature general-purpose I/O and various communication modules (USART, SPI, and TWI). PORTD and PORTF are mixed on the J3 header.

NOTE

The communication modules on PORTC and PORTF can be interconnected to test various functions and features: The USART can loop back communication with a jumper, or communicate between the two USARTs on the port. The native SPI and the USART in SPI master mode can be connected, and the TWI module can be enabled in both master and slave modes at the same time to get loop-back behavior. (Pull-up resistors can be mounted on R101 and R102. These are not mounted from the factory.)

5 Attached memories

The Atmel XMEGA-A1 Xplained kit demonstrates how to use the external bus interface (EBI) module to connect a 4-bit SDRAM. An 8MB SDRAM (16Mb x 4) is attached in three-port EBI mode (PORTH, PORTK, and PORTJ).

6 Miscellaneous I/O

6.1 Mechanical button switches

Eight mechanical button switches are connected to XMEGA PORTD(PD0:PD5) and PORTR(PR0:PR1). Internal pull-ups should be enabled to detect when the buttons are pushed, as they short the respective line to GND.

NOTE

Buttons share the pins with the J3 header: Pushing the buttons potentially affects communication or other functionality on these pins.

6.2 LEDs

Eight yellow LEDs are connected to XMEGA PORTE. The LEDs are active low, and thus light up when the respective lines are output low by the XMEGA.

One green and one red LED are inside the same package and therefore the colors can be mixed to orange when both are activated. The red LED can be activated by driving the connected I/O line to GND. The green LED is controlled via a FET and is by default on when the board is powered. However this power indicator LED can also be turned off by driving the gate of the FET to GND. Both LEDs are controlled by the Atmel AT32UC3B1256. The default firmware will use the red LED to signal activity on the UART to USB bridge by toggling the LED.

6.3 Analog I/O

An NTC temperature sensor and a light sensor are connected to PORTB on PB0 and PB1, respectively. These analog references can be used as input to the ADC.

An audio amplifier (and mono speaker) is connected to PORTB on pin PB2. This pin is connected to the XMEGA DAC, and thus offers a way to generate sound.

7 Included code example

The example application is based on the Atmel AVR Software Framework found online at http://asf.atmel.no. For documentation, help, and examples on the drivers used, please see the website.

For more information about the included code example, see the Atmel application note “AVR1927: XMEGA-A1 Xplained Getting Started Guide”.

7.1 Compiling and running

The code examples to be found in ASF can be compiled by running make on the makefile included in the project, or by opening the project in IAR™, and compiling the project within IAR.

8 Further code examples and drivers

Several Getting-Started trainings for the Atmel XMEGA-A1 Xplained kit can be downloaded from the Atmel website. These trainings offer general introduction to XMEGA peripherals. Please refer to AVR1500 through AVR1510.

Further information and drivers for XMEGA can be downloaded as application notes, also distributed from the Atmel website.

9 Known issues

9.1 Light sensor

The output range of the light sensor is 0V – 3.3V. The ADC reference must therefore be high enough to match the output range of the light sensor when performing measurements.

9.2 USB test points

Touching the test points of the USB data lines on the reverse side of the board while there is an ongoing communication, might interrupt the device and cause the device to stop responding. The kit must be reconnected to start working properly again.

9.3 PDI initialization

Because JTAG_TDO and PDI_DATA are connected on the PCB for this kit, JTAG must be disabled on the device in order to use PDI. The reason for this is that when JTAG is enabled it will enable a pull-up internally on TDO which interferes with the PDI initialization sequence.

The connection of JTAG_TDO with PDI_DATA is also an issue when the application on the device uses the JTAG_TDO pin e.g. by driving this pin actively or by using a pull-up. This will interfere with ongoing PDI communication. Additionally, when JTAG is disabled and the application is driving the JTAG_TDO pin it might even not be possible to establish a PDI connection. A workaround for this is to add a ~1k resistor from PDI_CLK/RESET to GND. This will keep the device in reset while PDI is enabled. When a PDI connection is established the flash can be erased or JTAG can be enabled in order to "unlock" the kit.

10 Revision history

The revision of the evaluation kit can be found on the sticker on the reverse side of the PCB.

10.1 Revision 7

The Atmel XMEGA-A1 Xplained kit, revision 7, is the first released revision of the XMEGA-A1 Xplained kit.

This kit replaces the Atmel Xplain evaluation kit. Information about the original Xplain evaluation kit can be found in the Atmel application note AVR1907: Xplain Hardware User's Guide.

10.2 Revisions 1 to 6

Not released.

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Atmel Corporation
2325 Orchard Parkway
San Jose, CA 95131
USA
Tel: (+1)(408) 441-0311
Fax: (+1)(408) 487-2600
www.atmel.com

Atmel Asia Limited
Unit 01-5 & 16, 19F
BEA Tower, Milennium City 5
418 Kwun Tong Road
Kwun Tong, Kowloon
HONG KONG
Tel: (+852) 2245-6100
Fax: (+852) 2722-1369

Atmel Munich GmbH
Business Campus
Parkring 4
D-85748 Garching b. Munich
GERMANY
Tel: (+49) 89-31970-0
Fax: (+49) 89-3194621

Atmel Japan
16F, Shin Osaki Kangyo Bldg.
1-6-4 Osaki Shinagawa-ku
Tokyo 104-0032
JAPAN
Tel: (+81) 3-6417-0300
Fax: (+81) 3-6417-0370

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